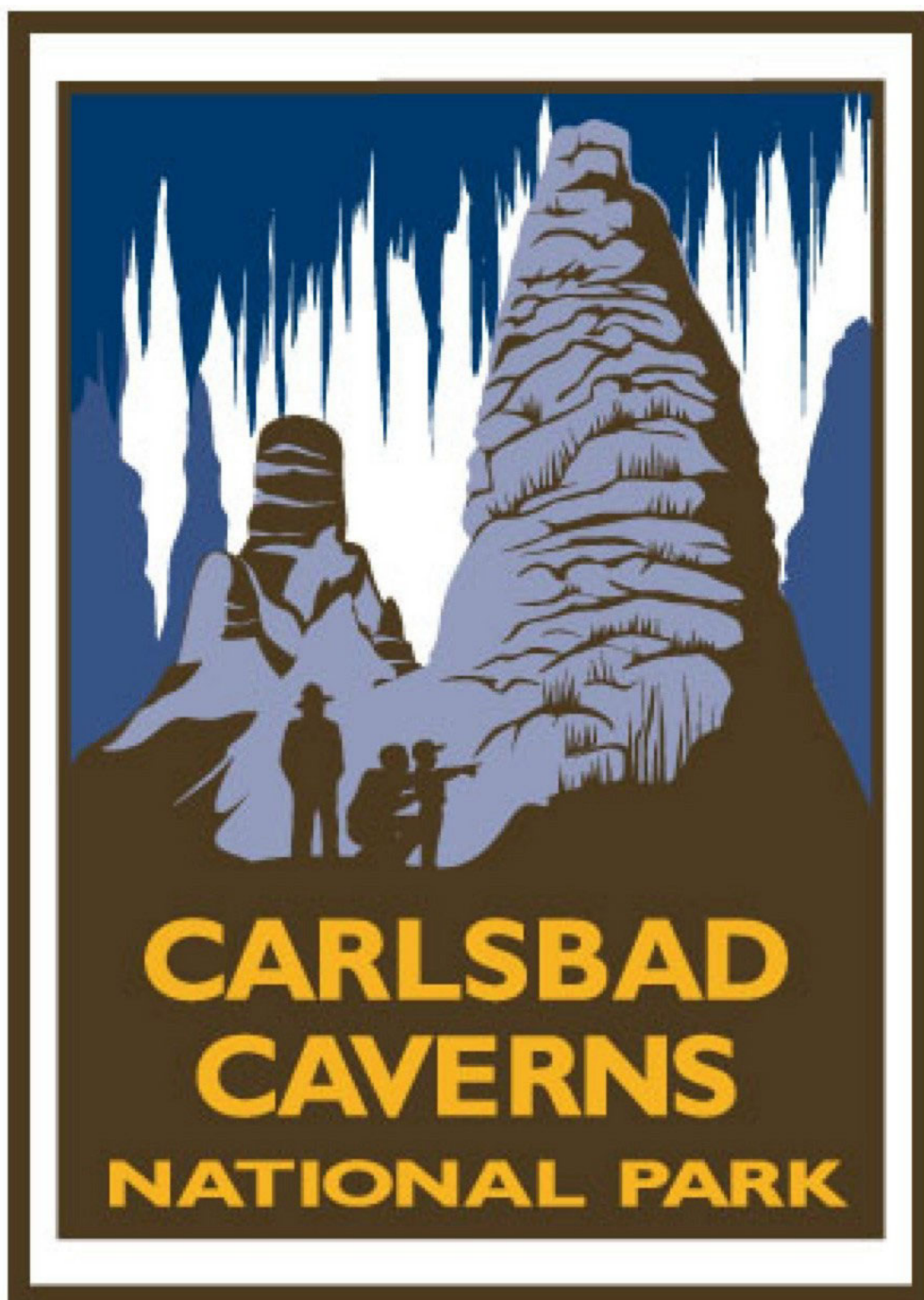


# Life Science

A curriculum and activity guide for Carlsbad Caverns National Park



## *Middle School Ecology*



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# Fire

The perception of fire and the influence of the media greatly affect the National Park Service's (and other agencies') management of the land and decisions made in the event of wildfire. Fire is the most influential ecological disturbance of the park's plant and wildlife. Fire has played a major role in shaping the grasslands that once dominated the park landscape. Very aggressive wildland fire suppression and extensive grazing of cattle and other domestic animals have drastically altered this grassland ecosystem. Grazing and fire suppression have favored the increased abundance and distribution of shrubs and succulent desert plants. Therefore, the animal population has changed because of the new plant community reducing biodiversity in the area.

This unit will focus on the basics of fire and its influence on the ecosystem. In the first activity, *Fire 101*, students conduct an in-class lab to learn the three ingredients of fire. In the second activity, *The Tree Ring Mysteries*, students are introduced to dendrochronology through the study of tree rings. The activity encourages students to carefully examine tree rings for evidence of fire in the tree's past. The students also develop a debate over the controversial issue of prescribed fire.



# Fire 101

## *What are the ingredients of a fire?*

**Summary:** This lesson is designed to help students understand the ingredients of a fire and what chemical reactions take place during a fire.

**Duration:** 1-2 class periods

**Setting:** Lab

**Vocabulary:** combustion, fuel, oxidation, dehydrated

**Standards/Benchmarks Addressed:** SC1-E2, SC2-E1, SC2-E2, SC2-E3, SC3-E1, SC4-E1, SC4-E2, SC4-E3, SC5-E1, SC5-E2, SC5-E3, SC6-E1, SC6-E2, SC6-E3, SC6-E4, SC6-E5, SC6-E6, SC9-E1, SC9-E2, SC9-E3, SC12-E1, SC12-E2, SC14-E1

### **Objectives**

Students will:

- explain the three ingredients of fire and the chemical reaction that causes rapid oxidation – combustion.

### **Background**

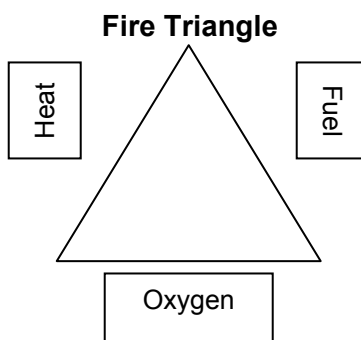
How do fires begin? In the Chihuahuan Desert, the main cause of fire is lightning strikes from thunderstorms. No matter what the cause every fire needs three ingredients—fuel, heat, and oxygen.

**Fuel:** Fuel is any combustible material. During the long summer months in the Chihuahuan Desert shrubs and dead grasses provide “dry fuel” and burn very easily. When years go by with no fire this dead plant material builds up, so when fire occurs, there is ample fuel to burn.

**Heat:** The typical climate of the area includes long, dry summers with very little rain. These conditions increase the temperature of the ground and the fuels there, making it easier for the fuel to ignite and burn. Dry fuel ignites easily from sources such as lightning, a campfire, a burning cigarette butt, or a match.

**Oxygen:** Wind is a typical occurrence in nature. The wind not only increases the oxygen supply and dries out the fuels it also influences the spread of fire. Shrubs are more quickly ignited when their small leaves are surrounded by plenty of oxygen.

Fire is a chemical reaction. When combined, the ingredients work together in this way. Start with a fuel, such as dry shrubs, which contains hydrogen and carbon atoms. When the summer sun hits the shrub, it raises the temperature of the shrub, drying it out. When an ignition source such as lightning contacts the shrub, it breaks the bonds between the carbon and the hydrogen. This allows them to react with O<sub>2</sub> in the air, releasing CO<sub>2</sub>, H<sub>2</sub>O, and heat-oxidation. Oxidation releases heat, which triggers more bonds, and more heat in a positive feedback cycle. This is known as combustion (burning).



The reaction, represented by the fire triangle, shows that fuel, heat, and oxygen are necessary to create fire. If any one of them is missing, there can be no fire.

### Materials

Ingredients of Fire worksheet  
Candles set up in aluminum pie pans or tin foil  
Matches  
Glass jars that fit over the candles

### Procedure

**Warm up:** Ask students what a fire needs to burn. What if one of the ingredients is missing? Do you still have a fire?

### Activity

1. Discuss the fire triangle. Tell students that all three elements—fuel, heat, and oxygen—are needed for a fire to burn. If one is missing there is no way that a fire can burn.
2. Divide the class into small groups and pass out the materials needed for the lab.
3. Light the candle.
4. Have the students observe the burning candle for three to five minutes. They must answer questions 1-5 on the Ingredients of Fire worksheet.
5. Students now place the glass jar over the burning candle until it rests on the table. Students observe the reaction and answer questions 6-7.
6. Have the students research the answers to sections B and C on the Ingredients of Fire worksheet.

**Wrap Up:** Have the students present their answers and discuss as a class.

### Assessment

Lab worksheet

### Extensions

Have students draw the fire triangle and label the parts.

# Ingredients of a Fire

Name: \_\_\_\_\_

A. Observe the burning candle.

1. What is the source of fuel?

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2. What is the source of heat?

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3. What is the source of oxygen?

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4. What is the evidence of oxidation?

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5. What color represents the hottest area of the flame?

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6. What happened when you eliminated one of the three ingredients of fire? Why?

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7. Explain the chemical reaction that took place:

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B. Why are more fires likely to burn during hot weather than during cool weather?

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C. Why would plants with smaller leaf surfaces burn faster than those with larger leaf surfaces?

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# Tree Ring Mysteries

*What can you learn from a tree?*

**Summary:** This lesson is designed to help students understand what events have happened in an area using dendrochronology.

**Duration:** 1 week

**Setting:** Classroom/lab

**Vocabulary:** dendrochronology, wildfire, prescribed fire, prescriptions

**Standards/Benchmarks Addressed:** SC1-E1, SC2-E1, SC3-E1, SC4-E1, SC4-E3, SC4-E5, SC5-E2, SC6-E1, SC6-E2, SC6-E3, SC6-E4, SC6-E5, SC6-E6, SC6-E7, SC6-E8, SC11-E6, SC12-E2, SC14-E2, SC14-E3, SC15-E2, SC16-E1, SC16-E2, SC16-E3

## Objectives

Students will:

- explain how scientists use dendrochronology.
- understand the importance of tree rings.
- examine tree rings for age and significant events that have affected the tree's growth (fire, drought, etc.)
- debate the controversial issue of prescribed fires.

## Background

The major cause of wildland fires in Carlsbad Caverns National Park is lightning strikes during summer thunderstorms. These prairie and woodland fires are well documented in historical records. Tree ring studies have documented fire scars hundreds of years back. The science of studying the past by looking at tree rings is called dendrochronology. Scientists can learn a great deal from studying tree rings. For example, they can learn how old a tree is, when a fire occurred in the area, and they can also learn about the climate of an area.

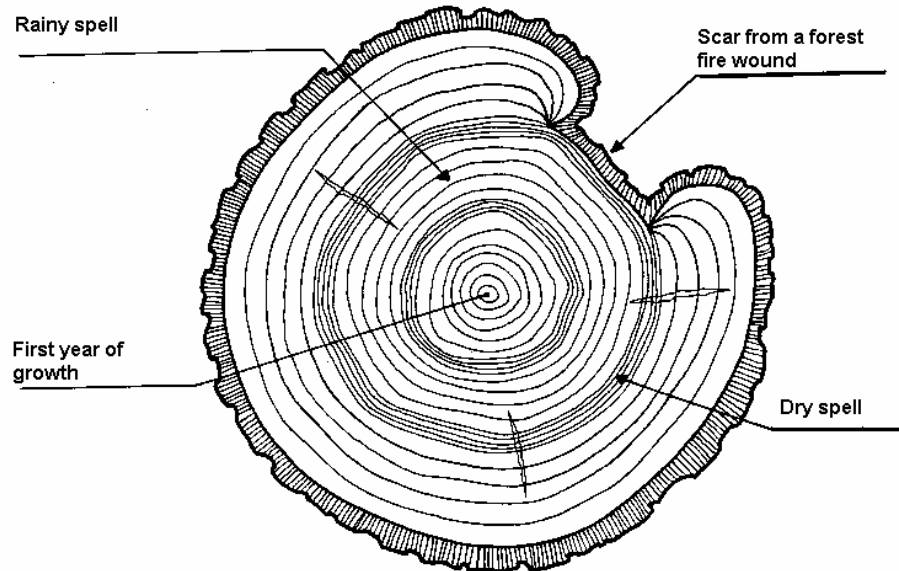
Fire is the most influential ecological disturbance of the park's plant and wildlife. Fire has played a major role in shaping the grasslands that once dominated the park landscape. Very aggressive wildland fire suppression and extensive grazing of cattle and other domestic animals have drastically altered this grassland ecosystem. Grazing and fire suppression have favored the increased abundance and distribution of shrubs and succulent desert plants. Therefore, the animal population has changed because of the new plant community reducing biodiversity in the area.

Prescribed fire is an essential tool to restore this out-of-balance ecosystem. First, some of the naturally ignited (lightning) fires are allowed to burn when certain predefined conditions (prescriptions) of wind speed and direction, relative humidity, and fuel moisture are met. Second, prescribed (controlled) fires are ignited at planned locations by trained fire personnel. These prescribed fires are conducted under controlled conditions and monitored by professional fire teams.

By studying a tree trunk, scientists can determine more than a tree's age. They can also learn about the weather in past years from its effects on the tree. Annual rings vary in width. Growth is much slower during periods of drought. A lack of water causes an annual ring to be narrow. A

year in which the temperatures are warmer than usual can have a long growing season. A longer growing season would provide a wider annual ring.

Below is a labeled tree ring.



### Materials

Tree Ring handout

Sample tree rings with evidence of a variety of events (fire, drought, etc...)

Lab worksheet (teacher created based on tree rings obtained)

### Procedure

**Warm up:** Ask students what they can learn from a tree. Write responses on the board and discuss. Pass out Reading Rings worksheet. Have students match the event on the right with a sample tree ring on the left. The tree rings can be used more than once. Discuss the background information for this lesson.

### Activity

1. Hand out the Tree Ring Handout. Have the students cut out the core samples at the bottom. Be sure they leave the letter on the core sample so they know which sample they are using.
2. Have the students decide which core sample matches the tree ring sample. They do this by laying the core sample across the tree ring looking for a matching pattern of lines. (Be sure that the students understand that core samples do not go farther than the core of the tree, so the core sample should not cross the center of the tree.) Ask students which core sample is the one that matches the tree ring.
3. Have the students observe the tree ring handout. Then have them assign dates to the important events in the tree's life. What year did fire scar the tree? (1915) How many years did it take the tree to grow around the remains of a dead branch? (10 years) How long did the drought that began in 1912 last? (2 years).
4. Hand out lab worksheet (teacher created). Have the students observe the tree rings arranged around the room and complete the lab questions (teacher created). Teacher may need to contact their local Extension Agent, National Park, or local Forestry official for the tree ring samples.



5. Discuss the need for fire in an ecosystem and how it brings balance to an unhealthy ecosystem. Discuss the need for prescribed fire.

### ***Wrap Up – Debate***

Survey the students' feelings on prescribed burns in the National Parks. Have each student research and prepare a debate on the opposite view than they possess (Try to divide the class as evenly as possible- some students may have to write on their own view to keep things even). If the student supports prescribed burns they take the stance against prescribed burns. If the student is against prescribed burns they take the stance for prescribed burns.

Give the students several days to work on the research for their portion of the debate project. Divide the class into debate groups of 4-6 (2 to 3 students from each side). Have each group debate the issue to the whole class.

### **Assessment**

Rubric for debate

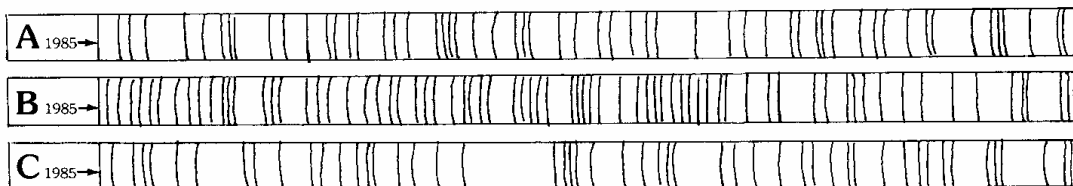
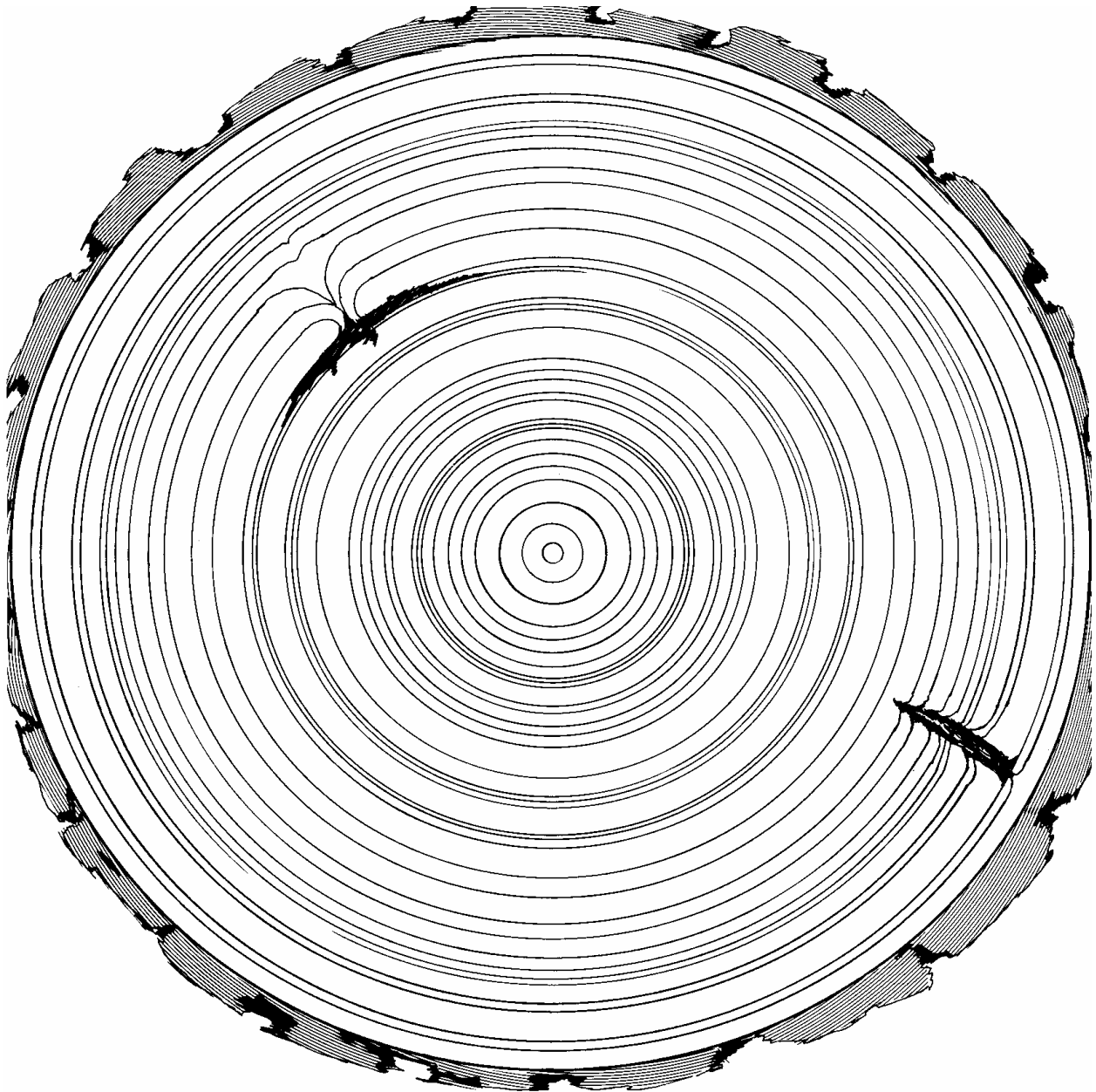
### **Extensions**

Take the students on a field trip to a local watershed, for instance, Smith Springs, in Guadalupe Mountains National Park. Have the students look for signs of a fire in the area's past. Have them write down any evidence they find that indicates that a fire has burned in the area.

Ask a firefighter from the local National Park to come to class and discuss the effects of wildfire and prescribed fire in the National Parks. Some questions they should cover include: Are all wildfires bad? Do they let some wildfires burn? Why or why not? What is a prescribed fire? Why do they have prescribed fires? What considerations do they have to look at before, during, and after a prescribed fire?

# Tree Ring Handout

**Directions:** Cut out the core samples labeled A-C at the bottom of this page. Be sure that you do not cut off the letter or dates on the core samples. Match the core sample to the tree ring sample by laying the core sample across the tree ring sample. Be sure that the core sample does not go further than the core of the tree.

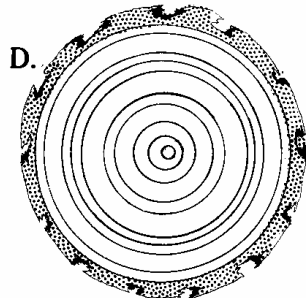
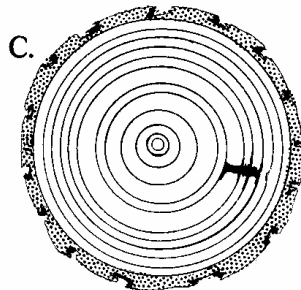
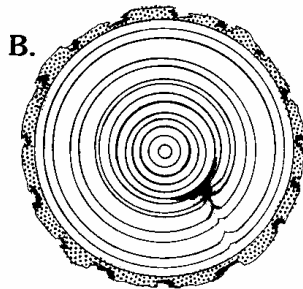
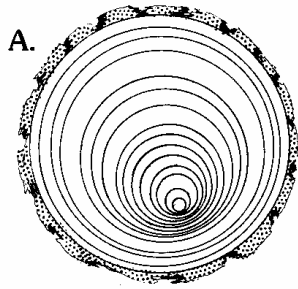


Worksheet adapted from: Ranger Rick's Nature Scope: Trees are Terrific!

# Reading Rings Worksheet

Name: \_\_\_\_\_

**Directions:** Carefully observe the rings on this worksheet and match them to the events on the opposite side. The rings may be used for more than one event.



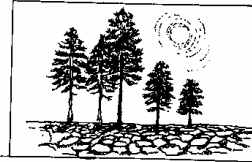
1. Fallen tree \_\_\_\_\_



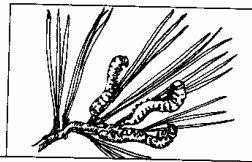
2. Fire \_\_\_\_\_



3. Drought \_\_\_\_\_



4. Insect attack \_\_\_\_\_



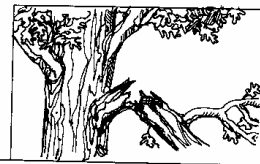
5. Construction \_\_\_\_\_



6. Growing on slope \_\_\_\_\_



7. Dead branch \_\_\_\_\_



Worksheet adapted from: Ranger Rick's Nature Scope: Trees are Terrific!

## Prescribed Fire

Debate	Self evaluation	Teacher evaluation	Comments
<b>Information:</b>		<b>/12</b>	
Includes detailed factual information			
Supports the assigned viewpoint			
Shows evidence of preparing for the opposing side's arguments			
<b>Presentation:</b>		<b>/16</b>	
Stays calm during the debate			
States argument clearly so people understand what is being said			
Shows eye contact with the other speaker and audience			
Speaks clearly and loudly so audience can hear		<b>/4</b>	
<b>Teamwork:</b>			
Are the efforts of each team member clearly demonstrated, or did it appear to be the work of one or two?			
<b>Overall:</b>		<b>/12</b>	
Has the student fulfilled all the parts of the task?			
Has the student used proper grammar and sentence structure?			
Has the student cited appropriate resources?			

4 no mistakes    3 few mistakes    2 many mistakes    1 incomplete (however is present)    0 not evident or not included

Percentages: Information \_\_\_\_\_ Presentation \_\_\_\_\_ Teamwork \_\_\_\_\_ Overall \_\_\_\_\_